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Teraue

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(54) **COLOR REPRODUCTION ASSISTING SYSTEM, COLOR REPRODUCTION ASSISTING METHOD, AND NON-TRANSITORY STORAGE MEDIUM**

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CPC ***G06K 15/1878*** (2013.01); ***H04N 1/54*** (2013.01); ***H04N 1/6058*** (2013.01)

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CPC ... H04N 1/6058; H04N 1/603; H04N 1/6052; H04N 1/60; H04N 1/6033; H04N 1/54; H04N 1/56; H04N 1/6019; H04N 1/6025; H04N 1/6055; H04N 1/6066; H04N 1/644; G06K 2215/0094
USPC 358/1.9, 2.1, 504, 406, 500, 400, 358/519–523, 515–516, 527; 382/162–167
See application file for complete search history.

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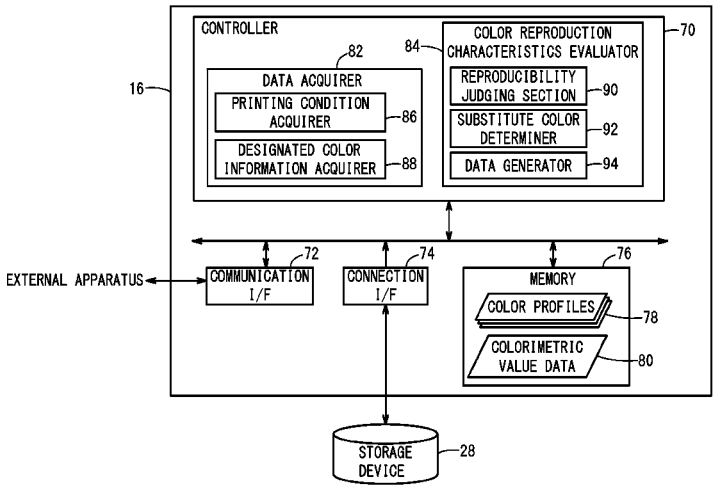
(57) **ABSTRACT**

A plurality of printing conditions and designated color information are acquired, and it is judged whether a designated color specified from the designated color information can be reproduced under the printing conditions or not. On condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, then a substitute color that is different from the designated color is determined in order to increase the number of the printing conditions under which the designated color can be reproduced. A display device displays visible information (colorimetric value display field, color difference display field, and color patch group) with respect to the substitute color.

5 Claims, 12 Drawing Sheets



(51) **Int. Cl.**
H04N 1/54 (2006.01)
H04N 1/60 (2006.01)

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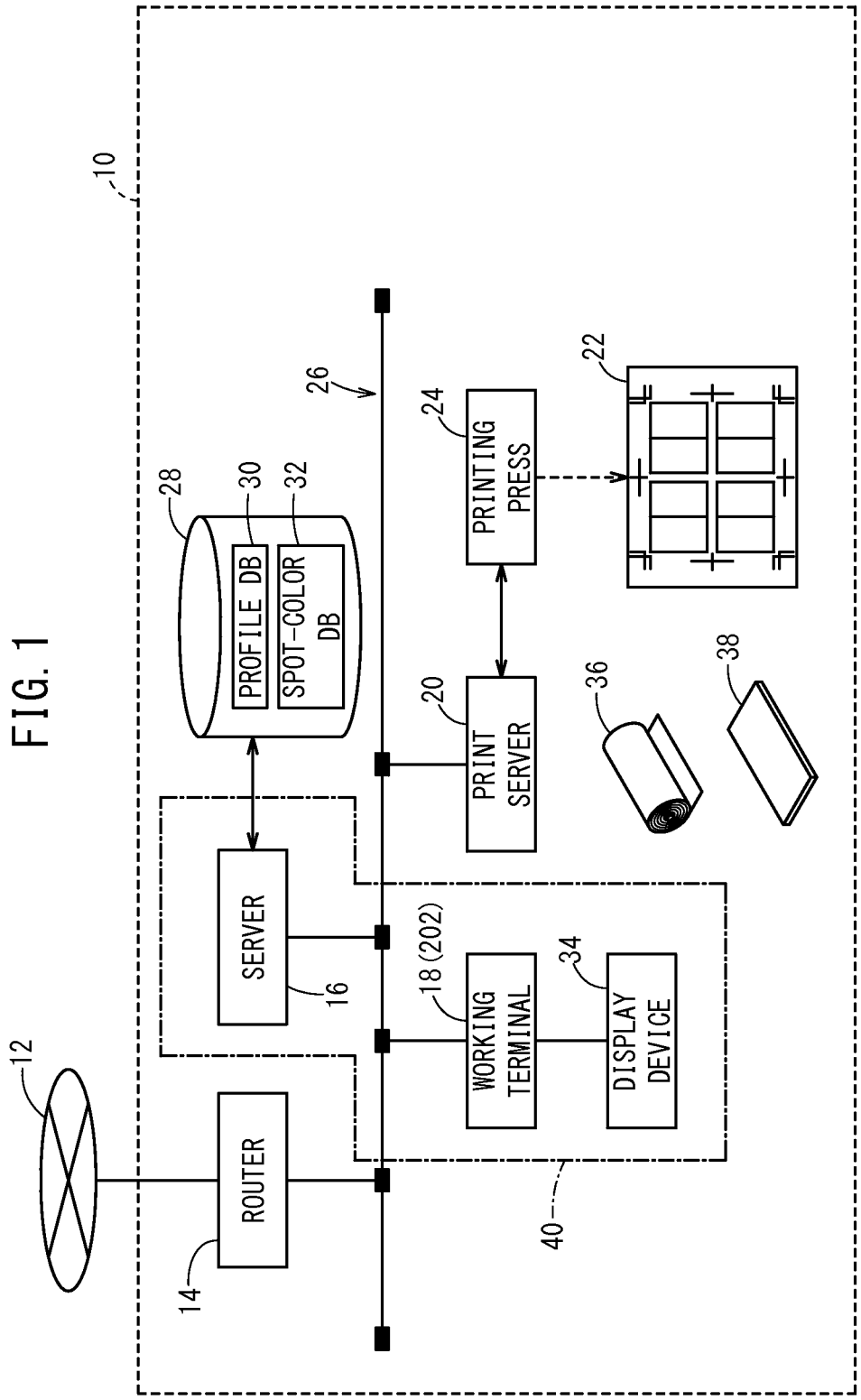
FIG. 1


10
12
14
ROUTER
16
SERVER
18 (202)
WORKING TERMINAL
20
PRINT SERVER
22
24
PRINTING PRESS
26
28
PROFILE DB
30
SPOT-COLOR DB
32
34
DISPLAY DEVICE
36
38
40

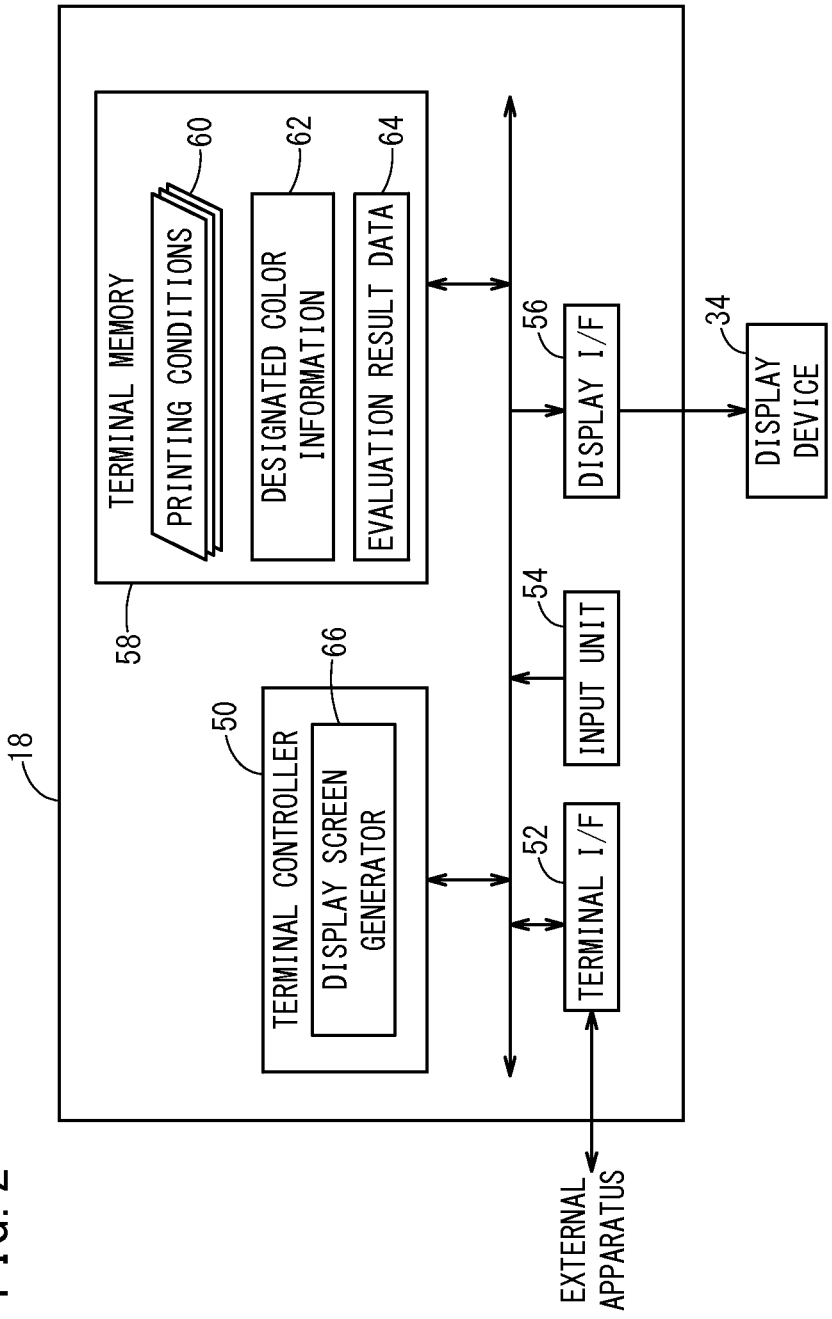

18
TERMINAL MEMORY
PRINTING CONDITIONS
60
DESIGNATED COLOR INFORMATION
62
EVALUATION RESULT DATA
64
58
TERMINAL CONTROLLER
DISPLAY SCREEN GENERATOR
66
50
INPUT UNIT
54
DISPLAY I/F
56
DISPLAY DEVICE
34
TERMINAL I/F
52
EXTERNAL APPARATUS

FIG. 2

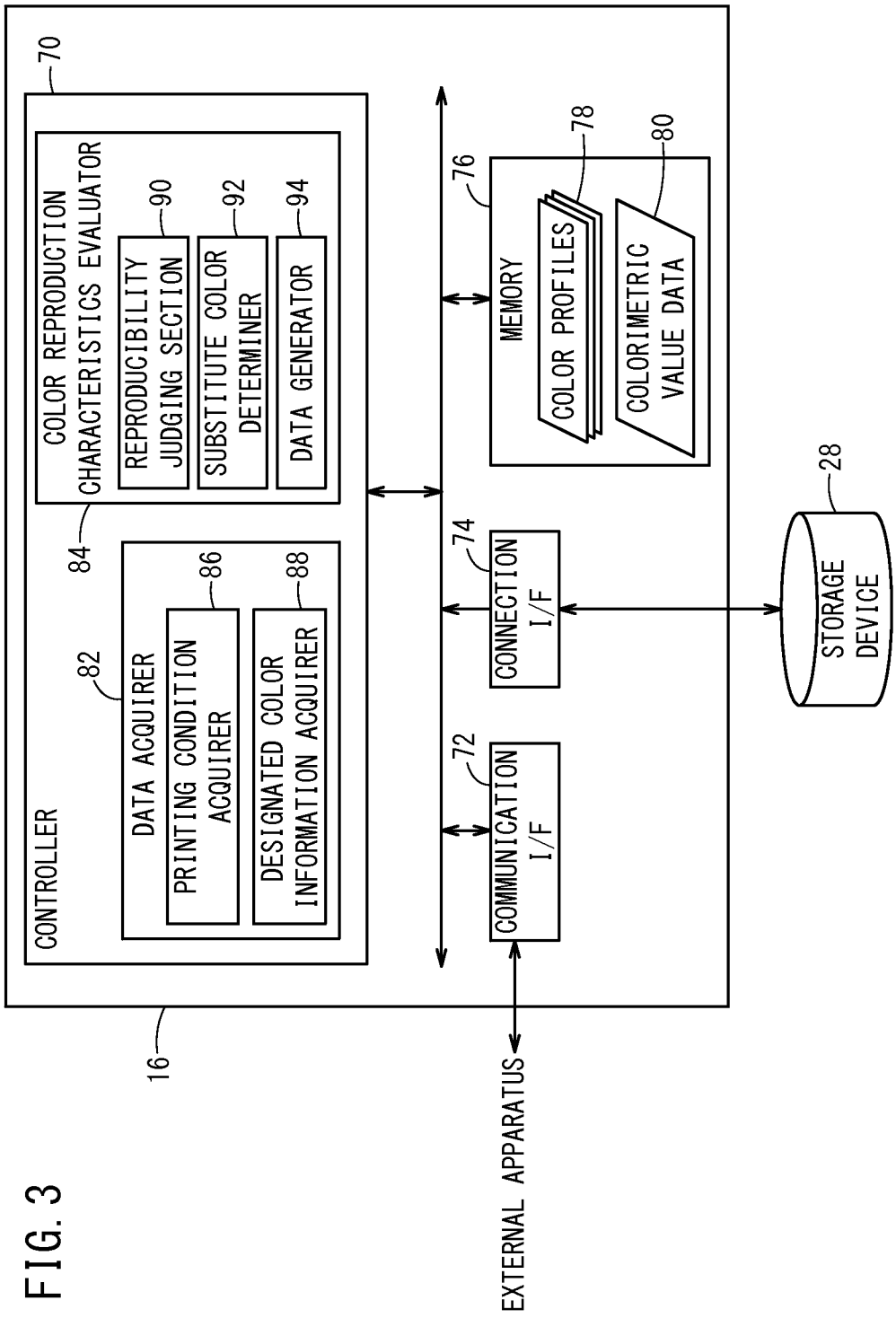
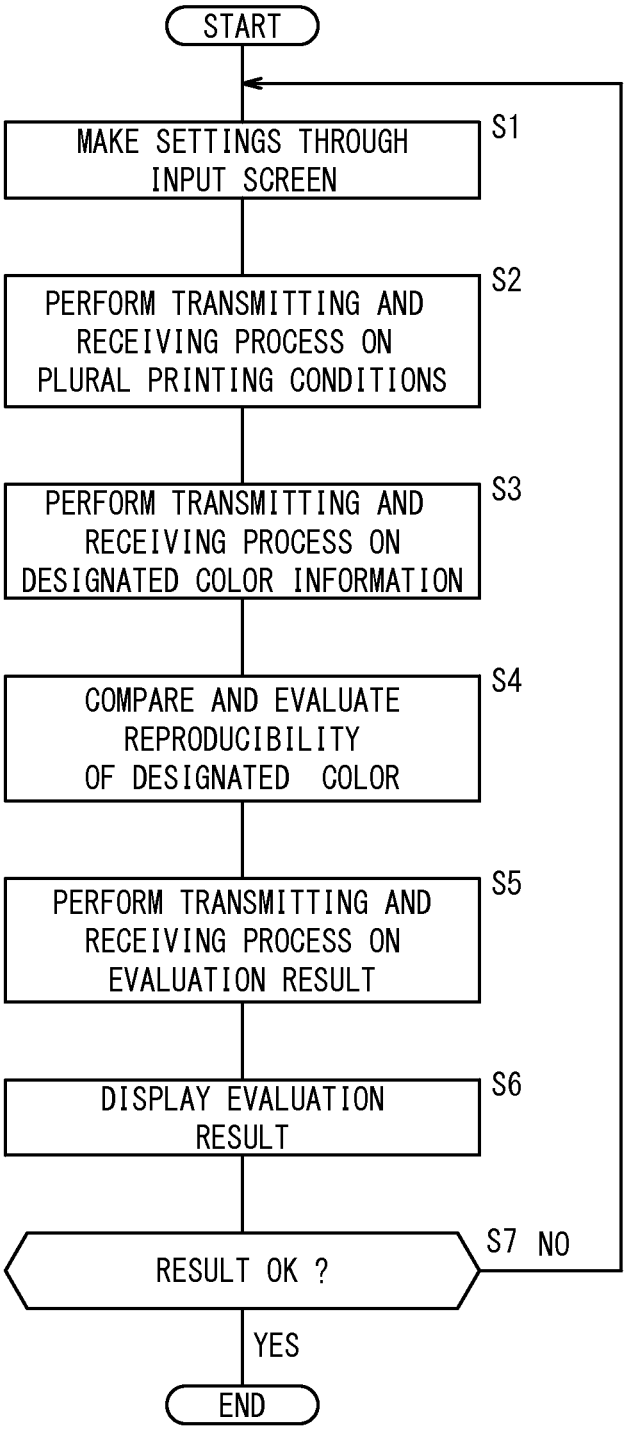

70
CONTROLLER
COLOR REPRODUCTION CHARACTERISTICS EVALUATOR
REPRODUCIBILITY JUDGING SECTION
SUBSTITUTE COLOR DETERMINER
DATA GENERATOR
84
DATA ACQUIRER
PRINTING CONDITION ACQUIRER
DESIGNATED COLOR INFORMATION ACQUIRER
82
86
88
90
92
94
76
MEMORY
COLOR PROFILES
COLORIMETRIC VALUE DATA
78
80
74
CONNECTION I/F
72
COMMUNICATION I/F
28
STORAGE DEVICE
16
EXTERNAL APPARATUS

FIG. 3

FIG. 4


START
MAKE SETTINGS THROUGH INPUT SCREEN
S1
PERFORM TRANSMITTING AND RECEIVING PROCESS ON PLURAL PRINTING CONDITIONS
S2
PERFORM TRANSMITTING AND RECEIVING PROCESS ON DESIGNATED COLOR INFORMATION
S3
COMPARE AND EVALUATE REPRODUCIBILITY OF DESIGNATED COLOR
S4
PERFORM TRANSMITTING AND RECEIVING PROCESS ON EVALUATION RESULT
S5
DISPLAY EVALUATION RESULT
S6
RESULT OK ?
S7
NO
YES
END

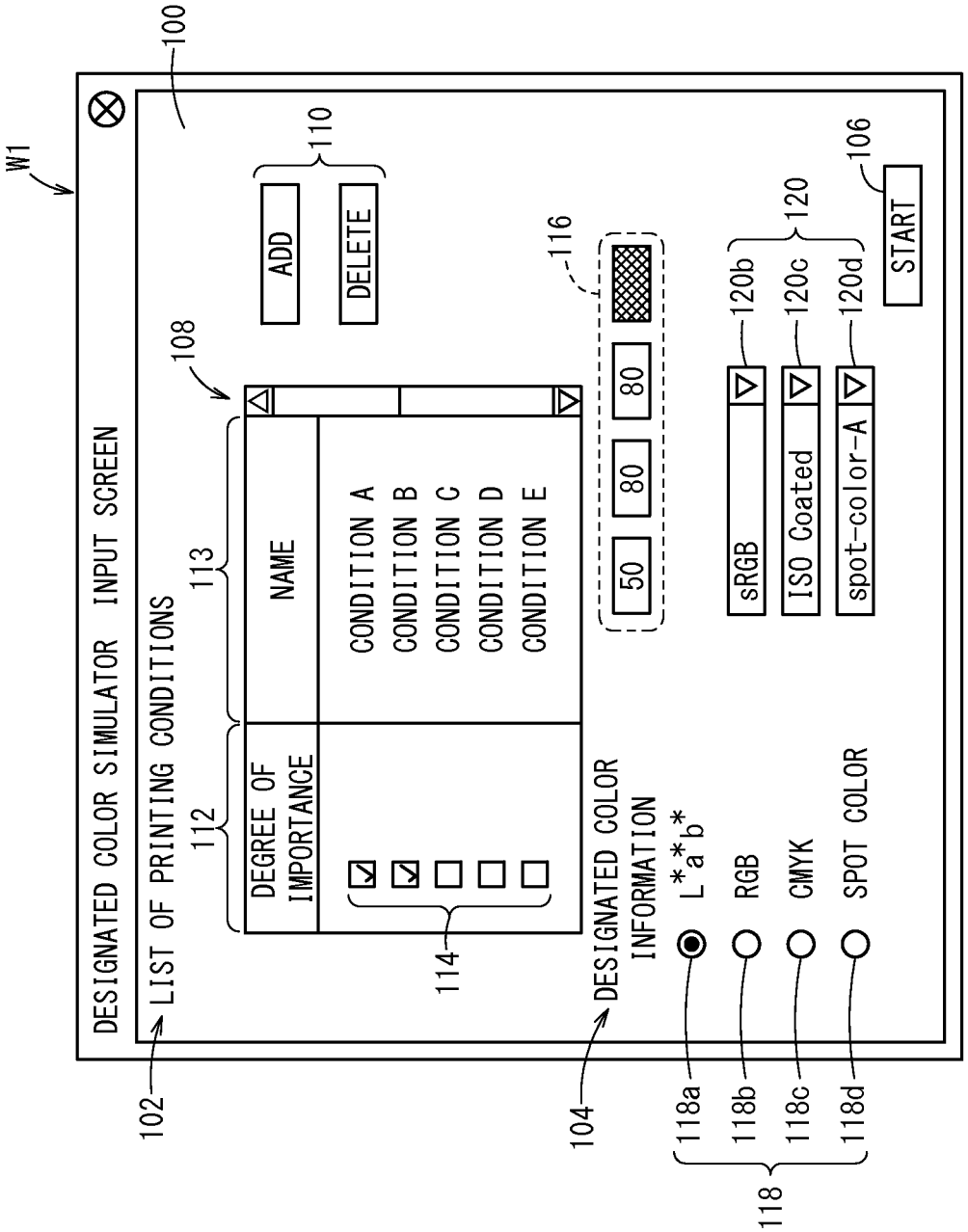

W1
100
DESIGNATED COLOR SIMULATOR INPUT SCREEN
LIST OF PRINTING CONDITIONS
102
108
113
112
DEGREE OF IMPORTANCE
NAME
CONDITION A
CONDITION B
CONDITION C
CONDITION D
CONDITION E
114
ADD
DELETE
110
116
50
80
80
DESIGNATED COLOR INFORMATION
104
L*a*b*
RGB
CMYK
SPOT COLOR
118a
118b
118c
118d
118
sRGB
ISO Coated
spot-color-A
120b
120c
120d
120
START
106

FIG. 5

FIG. 6

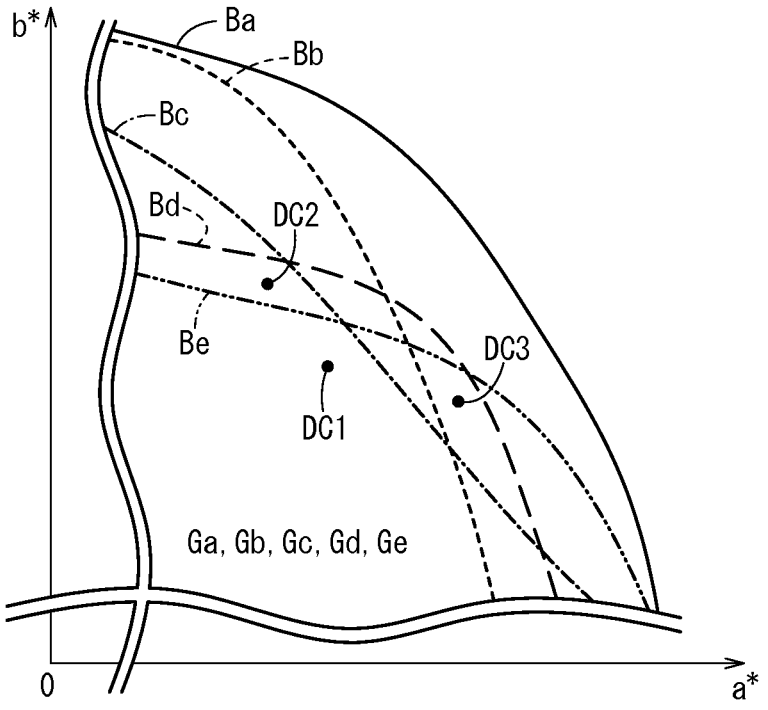


FIG. 7A

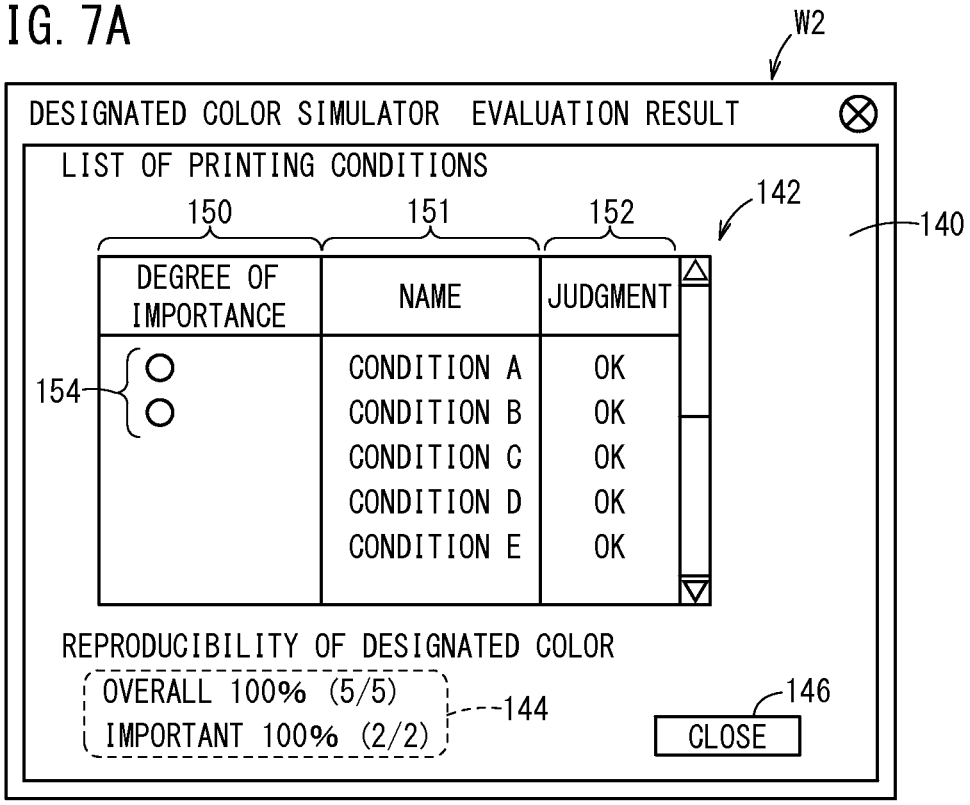

W2
DESIGNATED COLOR SIMULATOR EVALUATION RESULT
LIST OF PRINTING CONDITIONS
150
151
152
142
140
DEGREE OF IMPORTANCE
NAME
JUDGMENT
154
CONDITION A OK
CONDITION B OK
CONDITION C OK
CONDITION D OK
CONDITION E OK
REPRODUCIBILITY OF DESIGNATED COLOR
OVERALL 100% (5/5)
IMPORTANT 100% (2/2)
144
146
CLOSE

FIG. 7B

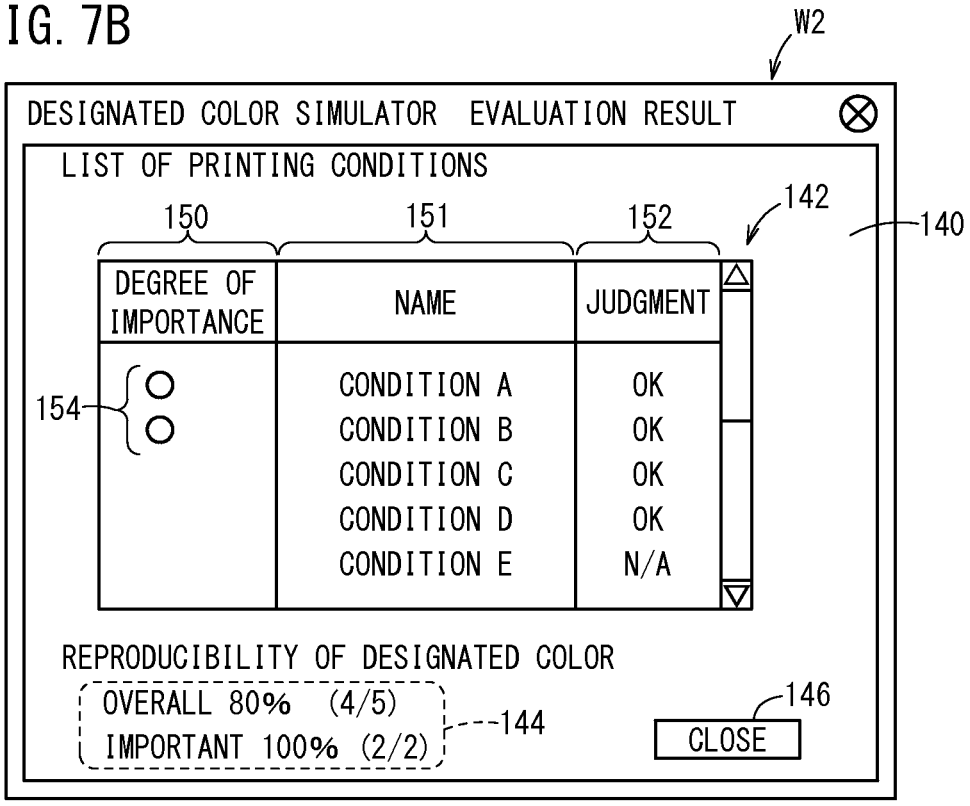

W2
DESIGNATED COLOR SIMULATOR EVALUATION RESULT
LIST OF PRINTING CONDITIONS
150
151
152
142
140
DEGREE OF IMPORTANCE
NAME
JUDGMENT
154
CONDITION A OK
CONDITION B OK
CONDITION C OK
CONDITION D OK
CONDITION E N/A
REPRODUCIBILITY OF DESIGNATED COLOR
OVERALL 80% (4/5)
IMPORTANT 100% (2/2)
144
146
CLOSE

FIG. 8

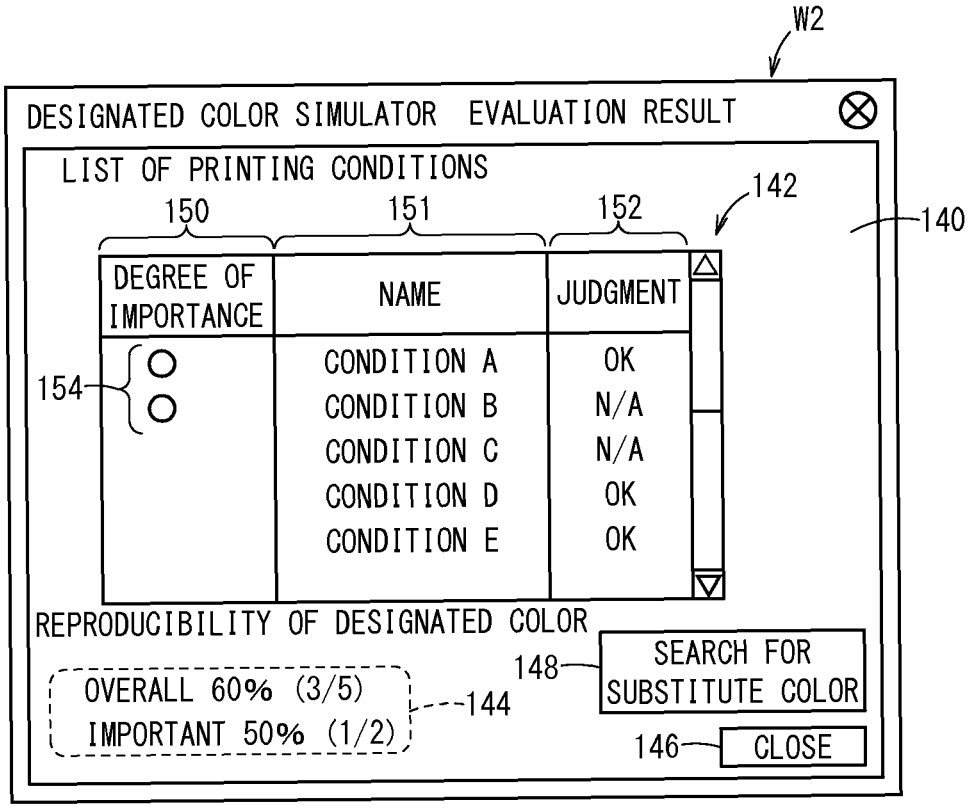

W2
DESIGNATED COLOR SIMULATOR EVALUATION RESULT
LIST OF PRINTING CONDITIONS
150
151
152
142
140
DEGREE OF IMPORTANCE
NAME
JUDGMENT
154
CONDITION A
OK
CONDITION B
N/A
CONDITION C
N/A
CONDITION D
OK
CONDITION E
OK
REPRODUCIBILITY OF DESIGNATED COLOR
OVERALL 60% (3/5)
IMPORTANT 50% (1/2)
144
148
SEARCH FOR SUBSTITUTE COLOR
146
CLOSE

FIG. 9A

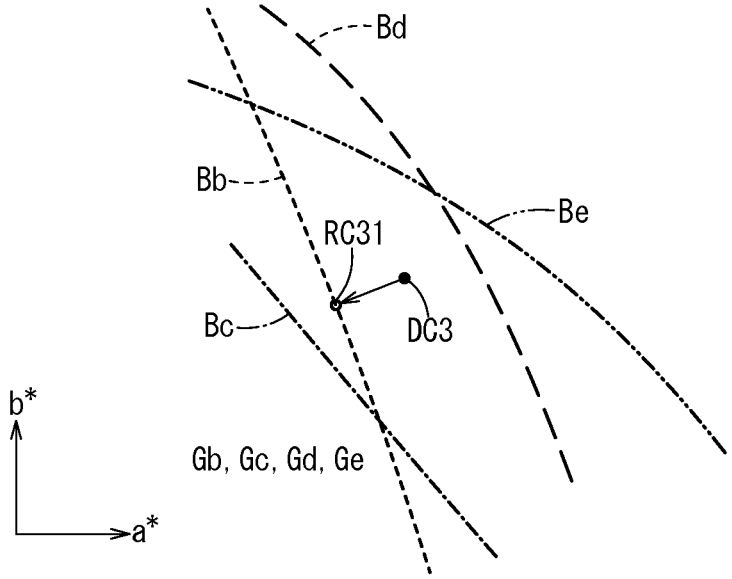

Bd
Bb
Be
RC31
DC3
Bc
b*
Gb, Gc, Gd, Ge
a*

FIG. 9B

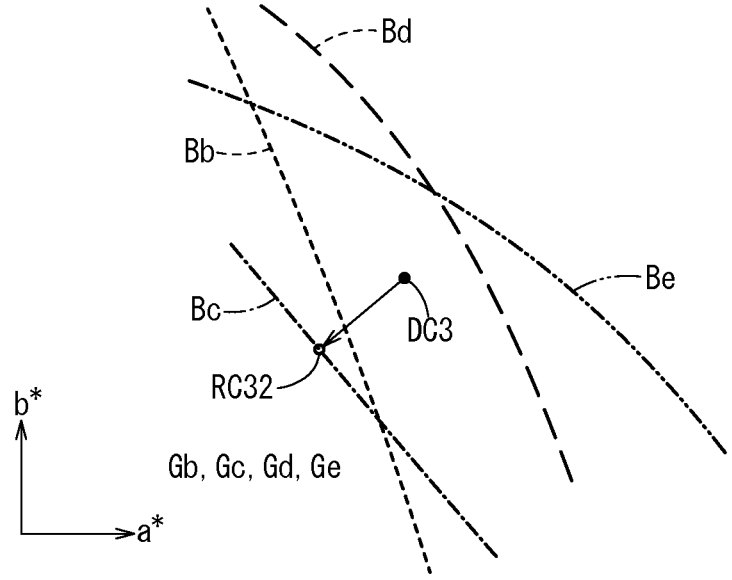

Bd
Bb
Be
Bc
DC3
RC32
b*
Gb, Gc, Gd, Ge
a*

FIG. 10

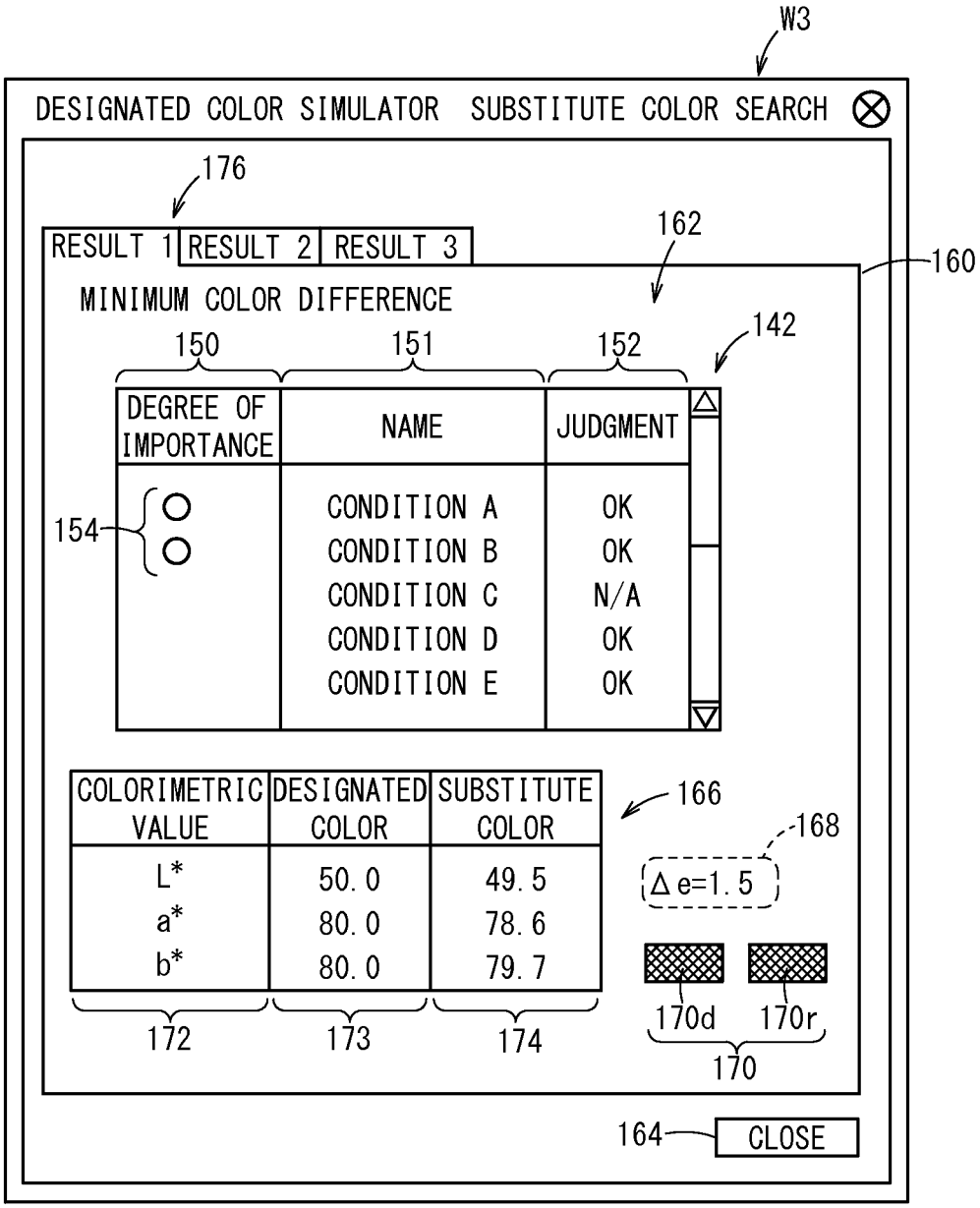

W3
DESIGNATED COLOR SIMULATOR SUBSTITUTE COLOR SEARCH
176
RESULT 1
RESULT 2
RESULT 3
162
160
MINIMUM COLOR DIFFERENCE
142
150
151
152
DEGREE OF IMPORTANCE
NAME
JUDGMENT
154
CONDITION A
OK
CONDITION B
OK
CONDITION C
N/A
CONDITION D
OK
CONDITION E
OK
COLORIMETRIC VALUE
DESIGNATED COLOR
SUBSTITUTE COLOR
166
168
L*
50.0
49.5
a*
80.0
78.6
b*
80.0
79.7
Δe=1.5
170d
170r
172
173
174
170
164
CLOSE

FIG. 11

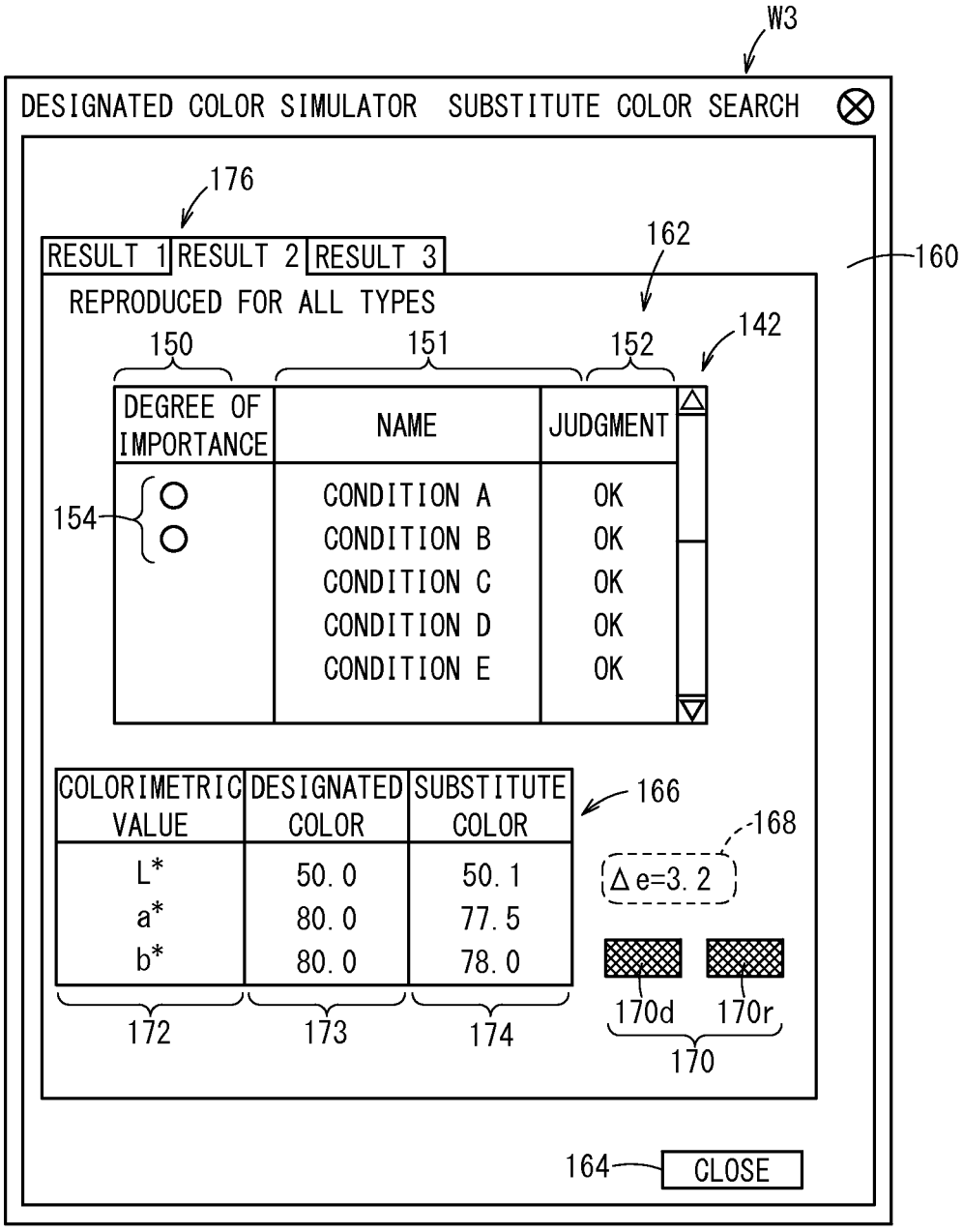
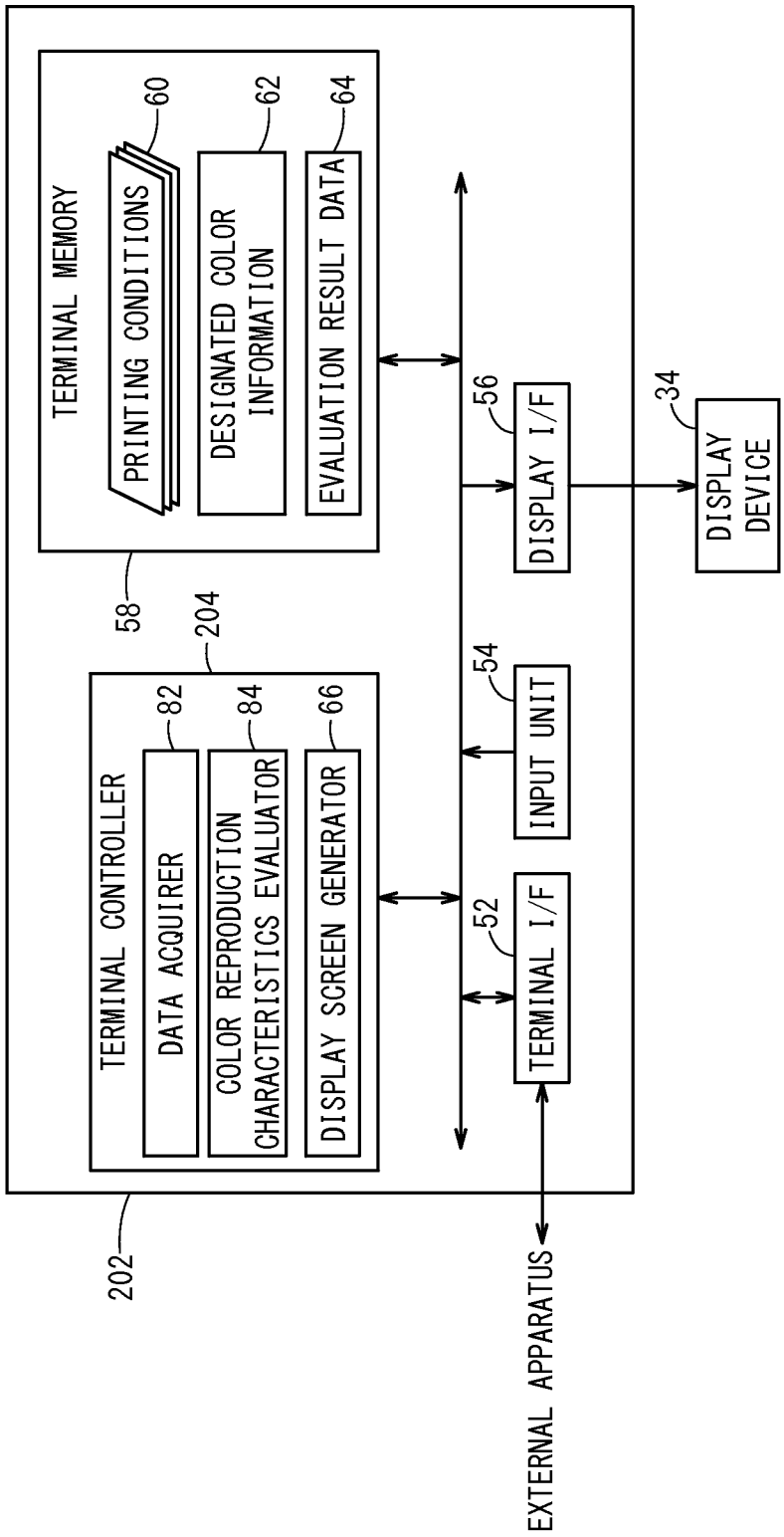

W3
DESIGNATED COLOR SIMULATOR SUBSTITUTE COLOR SEARCH
176
RESULT 1
RESULT 2
RESULT 3
162
160
REPRODUCED FOR ALL TYPES
150
151
152
142
DEGREE OF IMPORTANCE
NAME
JUDGMENT
154
CONDITION A OK
CONDITION B OK
CONDITION C OK
CONDITION D OK
CONDITION E OK
COLORIMETRIC VALUE
DESIGNATED COLOR
SUBSTITUTE COLOR
166
168
L* 50.0 50.1
a* 80.0 77.5
b* 80.0 78.0
Δe=3.2
170d
170r
170
172
173
174
164
CLOSE

FIG. 12


200
202
TERMINAL MEMORY
PRINTING CONDITIONS
60
DESIGNATED COLOR INFORMATION
62
EVALUATION RESULT DATA
64
58
204
TERMINAL CONTROLLER
DATA ACQUIRER
82
COLOR REPRODUCTION CHARACTERISTICS EVALUATOR
84
DISPLAY SCREEN GENERATOR
66
TERMINAL I/F
52
INPUT UNIT
54
DISPLAY I/F
56
DISPLAY DEVICE
34
EXTERNAL APPARATUS

COLOR REPRODUCTION ASSISTING SYSTEM, COLOR REPRODUCTION ASSISTING METHOD, AND NON-TRANSITORY STORAGE MEDIUM

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2013-184868 filed on Sep. 6, 2013, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a color reproduction assisting system, a color reproduction assisting method, and a non-transitory storage medium for assisting in the reproduction of designated colors on a print.

2. Description of the Related Art

Heretofore, there has been known in the printing field a technology for finely adjusting a color of an image into essential agreement with a color (hereinafter referred to as "designated color") designated by a color sample such as a color chip or the like. For faithfully reproducing a designated color, it is important to judge whether the designated color is present within the gamut of a printing press or not. Various processes have been proposed to predict whether a designated color can be reproduced or not and let the operator know the predicted result.

Japanese Laid-Open Patent Publication No. 2011-166731 discloses a process of displaying a list of the attributes and items of print mediums and the distances up to gamut boundaries. The operator can select the type of a print medium that is suitable for reproducing a designated color by confirming the details of the displayed list.

SUMMARY OF THE INVENTION

The present invention has been made with respect to the technical concept disclosed in Japanese Laid-Open Patent Publication No. 2011-166731. It is an object of the present invention to provide a color reproduction assisting system, a color reproduction assisting method, and a non-transitory storage medium which are capable of presenting the operator with information that is especially useful for reproducing a single designated color under a plurality of printing conditions.

According to the present invention, there is provided a color reproduction assisting system comprising a printing condition acquirer that acquires a plurality of printing conditions, a designated color information acquirer that acquires designated color information with respect to a single designated color, a reproducibility judging section that judges whether the designated color specified from the designated color information acquired by the designated color information acquirer can be reproduced under the printing conditions acquired by printing condition acquirer or not, a substitute color determiner that determines a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present by the reproducibility judging section, and a display device that displays visible information with respect to the substitute color determined by the substitute color determiner.

Thus, on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, the reproducibility judging section is provided for determining a substitute color that is different from the designated color in order to increase the number of the printing conditions under which the designated color can be reproduced, and the display device is provided for displaying visible information with respect to the substitute color. Consequently, the color reproduction assisting system is capable of presenting particularly useful information to the operator thereof in reproducing the single designated color under the printing conditions. The color reproduction assisting system is capable of presenting particularly useful information in reproducing the single designated color under the printing conditions.

The substitute color determiner may preferably determine a color whose color difference from the designated color is minimum as the substitute color on condition that the number of the printing conditions under which the designated color can be reproduced remains the same.

The display device may preferably display a color patch of the designated color and a color patch of the substitute color, arranged in a juxtaposed array as the visible information.

The printing condition acquirer may further acquire degrees of importance allotted to the printing conditions, respectively, and the substitute color determiner may preferably determine the substitute color so that the designated color can be reproduced under all printing conditions whose degrees of importance are higher than other printing conditions.

According to the present invention, there is also provided a color reproduction assisting method comprising the steps, to be carried out by at least one computer, of acquiring a plurality of printing conditions, acquiring designated color information with respect to a single designated color, judging whether the designated color specified from the designated color information can be reproduced under the printing conditions that are acquired or not, determining a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, and displaying visible information on a display device with respect to the substitute color that is determined.

According to the present invention, there is further provided a non-transitory storage medium storing a program for enabling at least one computer to carry out the steps of acquiring a plurality of printing conditions, acquiring designated color information with respect to a single designated color, judging whether the designated color specified from the designated color information can be reproduced under the printing conditions that are acquired or not, determining a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, and displaying visible information on a display device with respect to the substitute color that is determined.

According to the present invention, there is further provided a program for enabling at least one computer to carry out the steps of acquiring a plurality of printing conditions, acquiring designated color information with respect to a single designated color, judging whether the designated color

specified from the designated color information can be reproduced under the printing conditions that are acquired or not, determining a substitute color that is different from the designated color in order to increase the number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, and displaying visible information on a display device with respect to the substitute color that is determined.

With the color reproduction assisting system, the color reproduction assisting method, and the non-transitory storage medium described above, on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present, a substitute color that is different from the designated color is determined in order to increase the number of the printing conditions under which the designated color can be reproduced, and visible information with respect to the substitute color is displayed. Consequently, particularly useful information can be presented to the operator thereof in reproducing the single designated color under the printing conditions.

The above and other objects, features, and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing an overall configuration of a print production system incorporating a color reproduction assisting system according to an embodiment of the present invention;

FIG. **2** is an electric block diagram of a working terminal shown in FIG. **1**;

FIG. **3** is an electric block diagram of a server shown in FIG. **1**;

FIG. **4** is a flowchart of an operation sequence of the working terminal shown in FIG. **2** and the server shown in FIG. **3**;

FIG. **5** is a view showing an image representing an input screen for entering printing conditions and designated color information;

FIG. **6** is a graph showing the relationship between gamuts and a designated color under the printing conditions;

FIG. **7**A is a view showing a first image representing an evaluation result screen that shows evaluated color reproduction characteristics;

FIG. **7**B is a view showing a second image representing an evaluation result screen;

FIG. **8** is a view showing a third image representing an evaluation result screen;

FIGS. **9**A and **9**B are diagrams illustrating a process of searching for a substitute color;

FIG. **10** is a view showing a first image representing a search result screen that shows substitute colors that have been found;

FIG. **11** is a view showing a second image representing a search result screen that shows substitute colors that have been found; and

FIG. **12** is an electric block diagram of a color reproduction assisting system according to a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A color reproduction assisting method according to a preferred embodiment of the present invention in relation to a color reproduction assisting system and a color reproduction assisting program for carrying out the color reproduction assisting method will be described in detail below with reference to the accompanying drawings.

[Overall Configuration of Print Production System **10**]

FIG. **1** shows in block form an overall configuration of a print production system **10** incorporating a color reproduction assisting system **40** according to an embodiment of the present invention.

As shown in FIG. **1**, the print production system **10** includes a router **14** serving as a device for connection to a network **12**, a server **16** which is accessible through the network **12** from terminal devices, not shown, belonging to external networks, a working terminal **18** for performing various information processing processes on contents data acquired from the server **16**, etc., a print server **20** having a printing process function, and a printing press **24** for producing a print **22** based on output data sent from the print server **20**.

The server **16** is an apparatus that plays a central role in the workflow management in the print production system **10**. The server **16** is connected to the working terminal **18** and the print server **20** for communication therewith through a LAN (Local Area Network) **26** set up in the print production system **10**. The server **16** may be connected to various terminal devices of designers or production companies, not shown, for communication therewith through the router **14** and the network **12**.

A storage device **28** capable of storing various data about a workflow is connected to the server **16**. The storage device **28** stores contents data, data to be output (hereinafter referred to as "output data"), e.g., platemaking data, printing plate data, or proof data, job ticket files {e.g., JDF (Job Definition Format) files}, color profiles, color sample data, etc. In FIG. **1**, a database with respect to color profiles (hereinafter referred to as "profile DB **30**") and a database with respect to spot color information (hereinafter referred to as "spot-color DB **32**") are set up in the storage device **28**.

The working terminal **18** is a device that performs a preflight process on contents data representing characters, figures, patterns, photographs, etc. and then generating data per page (page data) from the processed contents data. The working terminal **18** also performs an imposing process according to a binding process and a page folding process which have been designated, by referring to the tag information of a job ticket.

A display device **34** for displaying desired images for various working sequences is connected to the working terminal **18**. The display device **34** may comprise a liquid crystal display panel, an organic EL (ElectroLuminescence) display panel, a cathode-ray tube (CRT), or a projector for projecting images onto a screen.

The print server **20** performs an RIP (Raster Image Processing) process on platemaking data, etc. that have been imposed, and supplies generated output data to the printing press **24**.

Based on the output data supplied from the print server **20**, the printing press **24** produces a print **22** that has images on a print medium **36**. The print medium **36** may comprise a paper medium such as synthetic paper, thick paper, aluminum-evaporated paper, or the like, a resin medium such as vinyl chloride, PET (polyethylene terephthalate), or the like, or tarpaulin paper, metal sheet, or the like.

On condition that the printing press **24** comprises a proofer, then it may comprise a DDCP (Direct Digital Color Proofer), an ink jet color proofer, a low-resolution color laser printer (electrophotographic printer), an ink jet printer, or the like.

On condition that the printing press **24** comprises a letterpress printing press, then it produces a print **22** which has images printed on a print medium **36** by applying inks to the print medium **36** through printing plates **38** and intermediate transfer members, not shown.

On condition that the printing press **24** comprises a digital printing press, it can directly produce a print **22** without the need for generating printing plates **38**. The digital printing press may comprise an ink jet printing press, a wide-format printing press, an ink jet color proofer, a color laser printer, or the like.

The server **16**, the working terminal **18**, and the display device **34** jointly make up the color reproduction assisting system **40** for reproducing a color (designated color to be described later) designated by a color sample such as a color chip or the like.

[Electric Block Form of Working Terminal **18**]

FIG. **2** shows in electric block form the working terminal **18** shown in FIG. **1**. As shown in FIG. **2**, the working terminal **18** basically comprises a computer having a terminal controller **50**, a terminal I/F **52**, an input unit **54**, a display I/F **56**, and a terminal memory **58** (storage medium).

The terminal I/F **52** is an interface for sending electric signals to and receiving electric signals from an external apparatus. The working terminal **18** can acquire various data, e.g., evaluation result data **64**, from the server **16** (FIG. **1**), and can supply various data, e.g., printing conditions **60**, to the server **16**.

The input unit **54** comprises various input devices including a mouse, a track ball, a keyboard, a touch sensor, etc. The display I/F **56** is an interface for supplying display control signals to the display device **34**. In a case where the display device **34** is supplied with display control signals, the display device **34** displays various images including a window W1 (FIG. **5**), a window W2 (FIG. **7**A or the like), and a window W3 (FIG. **10** or the like).

The terminal memory **58** stores programs and data required for the terminal controller **50** to control various components of the working terminal **18**. In FIG. **2**, the terminal memory **58** stores a plurality of printing conditions **60**, designated color information **62**, and evaluation result data **64**.

The terminal controller **50** comprises an information processing unit, i.e., a processor, such as a CPU (Central Processing Unit) or the like. The terminal controller **50** reads out and executes programs stored in the terminal memory **58** thereby to carry out functions including a display screen generator **66**.

[Electric Setup of Server **16**]

FIG. **3** shows in electric block form the server **16** shown in FIG. **1**. As shown in FIG. **3**, the server **16** basically comprises a computer having a controller **70**, a communication I/F **72**, a connection I/F **74**, and a memory **76** (storage medium).

The communication I/F **72** is an interface for sending electric signals to and receiving electric signals from an external apparatus. The server **16** can acquire various data, e.g., printing conditions **60**, from the working terminal **18** (FIG. **1**), and can supply various data, e.g., evaluation result data **64**, to the working terminal **18**.

The connection I/F **74** is an interface for sending data files to and receiving data files from the storage device **28**. In response to a request from the server **16**, the storage device **28** can supply a color profile **78** related to printing conditions **60**, for example, to the server **16** through the connection I/F **74**.

The memory **76** stores programs and data required for the controller **70** to control various components of the server **16**. In FIG. **3**, the memory **76** stores a plurality of color profiles **78** and colorimetric value data **80**.

The memory **76** may comprise a non-transitory computer-readable storage medium. The computer-readable storage medium comprises a portable medium such as a magnetooptic disk, a ROM, a CD-ROM, a flash memory, or the like, or a storage medium such as a hard disk or the like incorporated in a computer system. The storage medium also includes a medium for dynamically holding programs for a short period of time, or a medium for holding programs for a certain period of time.

The controller **70** comprises an information processing unit such as a CPU or the like. The controller **70** reads out and executes programs stored in the memory **76** thereby to carry out functions including a data acquirer **82** and a color reproduction characteristics evaluator **84**.

The data acquirer **82** acquires various data for use in an evaluating process carried out by the color reproduction characteristics evaluator **84**. Specifically, the data acquirer **82** includes a printing condition acquirer **86** for acquiring a plurality of printing conditions **60** (FIG. **2**) and a designated color information acquirer **88** for acquiring designated color information **62**.

The "printing conditions" referred to above refer to composite conditions representing a combination of at least one condition item about printing. Condition items include a condition name (including the name of a data file), the type and name of the printing press **24**, the type and size of the print medium **36**, a plate size, color plates, a binding process, the type and customer name of a color profile **78**, and the type of a job. The condition items may include not only data directly involved in a printing process, but also data (so-called metadata) ancillary to those data. For offset printing, condition items include, for example, the printing press **24**, the print medium **36**, the printing plates **38**, inks, a halftone dot type, a resolution, a screen ruling, an angle set, and color converting conditions including a dot gain curve, a color profile **78**, etc.

The "designated color information" referred to above is information with respect to a color (hereinafter referred to as "designated color") designated by a color sample such as a color chip or the like. The designated color information includes not only a color sample itself, but also colorimetric values or type thereof. Colorimetric values represent, for example, tristimulus values X, Y, Z, device-independent data including values L*, a*, b* of a uniform color space, and device-dependent data including values R, G, B and values C, M, Y, K. The type of a color sample includes a manufacturer name, a color sample number, etc.

The color reproduction characteristics evaluator **84** carries out an evaluating process with respect to the reproducibility of a designated color. Specifically, the color reproduction characteristics evaluator **84** includes a reproducibility judging section **90** for judging whether a designated color can be reproduced under each printing condition **60**, a substitute color determiner **92** for determining a substitute color that is different from a designated color under predetermined conditions, and a data generator **94** for generating evaluation result data **64** based on the result of the evaluating process.

[Operation of Color Reproduction Assisting System **40**]

The color reproduction assisting system **40** according to the present embodiment is configured as described above. Operation of the working terminal **18** shown in FIG. **2** and the server **16** shown in FIG. **3** will be described in detail below with reference to a flowchart shown in FIG. **4**.

In step S**1** shown in FIG. **4**, the working terminal **18** makes various settings through an input screen **100** (see FIG. **5**). In response to an instruction for starting to make settings, the display screen generator **66** generates display data for the input screen **100**, and then supplies the generated display data

to the display I/F **56**. The display device **34** displays a window W1 including the input screen **100** based on the display data from the display I/F **56**.

As shown in FIG. **5**, the input screen **100** includes a first setting field **102**, a second setting field **104**, and a button **106** labeled "START". The operator of the working terminal **18** can operate the input unit **54** (FIG. **2**) to make various settings in the first setting field **102** or the second setting field **104**.

The first setting field **102** includes a list **108** (hereinafter referred to as "condition list **108**") of printing conditions **60** to be evaluated and a button group **110** having buttons labeled "ADD" and "DELETE". The condition list **108** includes a subfield **112** showing degrees of importance on a left side and a subfield **113** showing names on a right side.

The subfield **113** shows the name of at least one printing condition **60**. In FIG. **5**, the subfield **112** enumerates "CONDITION A", "CONDITION B", "CONDITION C", "CONDITION D", and "CONDITION E". The subfield **112** shows an array of checkboxes **114** associated with respective printing conditions **60** listed in the subfield **113**. The operator may operate the button group **110** to add a new printing condition **60** to the subfield **113** and to delete a printing condition **60** from the subfield **113**.

The second setting field **104** includes a text box group **116**, a radio button group **118**, and a pull-down menu group **120**.

The text box group **116** has text boxes for setting colorimetric values of a designated color. The radio button group **118** has radio buttons **118***a*, **118***b*, **118***c*, **118***d* for indicating values L*, a*, b*, values R, G, B, values C, M, Y, K, and spot-color values, respectively. The pull-down menu group **120** has pull-down menus **120***b*, **120***c*, **120***d* for setting names of color profiles **78**. In a case where the operator selects the radio button **118***a* of the radio button group **118**, the operator can enter values L*, a*, b* of a CIELAB color system as representing a designated color, using the text boxes of the text box group **116**.

In a case where the operator selects the radio button **118***b* of the radio button group **118**, the operator can enter values R, G, B of a device-depending color space as representing a designated color, using the text boxes of the text box group **116**. At this time, the operator also sets the name of a color profile **78**, i.e., "sRGB", registered in the profile DB **30** (FIG. **1**) using the pull-down menu **120***b*.

In a case where the operator selects the radio button **118***c* of the radio button group **118**, the operator can enter values C, M, Y, K of a device-depending color space as representing a designated color, using the text boxes of the text box group **116**. At this time, the operator also sets the name of a color profile **78**, i.e., "ISO Coated", registered in the profile DB **30** using the pull-down menu **120***c*.

In a case where the operator selects the radio button **118***d* of the radio button group **118**, the operator can enter values of a spot color as representing a designated color, using the text boxes of the text box group **116**. At this time, the operator also sets the name of the spot color, i.e., "spot-color-A", registered in the spot-color DB **32** (FIG. **1**) using the pull-down menu **120***d*.

The terminal controller **50** judges whether the operator has clicked on the "START" button **106** using the input unit **54** or not. On condition that the terminal controller **50** judges that the operator has clicked on the "START" button **106**, then control goes to step S**2**.

In step S**2**, the color reproduction assisting system **40** performs a transmitting and receiving process on a plurality of printing conditions **60**. Prior to the transmitting and receiving process, the terminal controller **50** temporarily stores a plurality of printing conditions **60** in the terminal memory **58**. The working terminal **18** transmits communication data including the printing conditions **60** to the server **16** through the terminal I/F **52**. The server **16** receives the communication data transmitted through the LAN **26** and the communication I/F **72**.

Thereafter, the controller **70** (printing condition acquirer **86**) acquires the printing conditions **60** included in the communication data. In FIG. **5**, five conditions, i.e., "CONDITION A", "CONDITION B", "CONDITION C", "CONDITION D", and "CONDITION E", are acquired as the printing conditions **60**. Since the checkboxes **114** corresponding to "CONDITION A" and "CONDITION B" are ticked in FIG. **5**, higher degrees of importance are given to these printing conditions **60**.

In step S**3**, the color reproduction assisting system **40** performs a transmitting and receiving process on designated color information **62**. Prior to the transmitting and receiving process, the terminal controller **50** temporarily stores designated color information **62** in the terminal memory **58**. The working terminal **18** transmits communication data including the designated color information **62** to the server **16** through the terminal I/F **52**. The server **16** receives the communication data transmitted through the LAN **26** and the communication I/F **72**.

Thereafter, the controller **70** (designated color information acquirer **88**) acquires the designated color information **62** included in the communication data. In FIG. **5**, colorimetric values (L*, a*, b*=50, 80, 80) are acquired as the designated color information **62**. The designated color information **62** may be acquired not only by a manual process using the input screen **100**, but also automatically as color sample information contained in a job ticket, for example.

In step S**4**, the color reproduction characteristics evaluator **84** compares and evaluates the reproducibility of the designated color under the printing conditions **60**. Before the reproducibility of the designated color is evaluated, the controller **70** refers to the profile DB **30** set up in the storage device **28**, and reads out color profiles **78** related to the respective printing conditions **60**. As necessary, the controller **70** refers to the profile DB **30** or the spot-color DB **32** set up in the storage device **28**, and acquires colorimetric value data **80**, i.e., values L*, a*, b*, related to the designated color information **62**.

The reproducibility judging section **90** judges whether the single designated color can be reproduced under the printing conditions **60** or not. Prior to the judgment, the reproducibility judging section **90** defines the ranges of gamuts Ga through Ge under the printing conditions **60** using color conversion tables which the color profiles **78** have.

FIG. **6** is a graph showing the relationship between the gamuts Ga through Ge and a designated color under the printing conditions **60**. FIG. **6** illustrates cross sections of the gamuts Ga through Ge taken along a plane (L*=50) with an L*-axis extending normal thereto. The graph shown in FIG. **6** has a horizontal axis representing a* and a vertical axis representing b*. For illustrative purposes, the ranges of the gamuts Ga through Ge are partly omitted from illustration, and are shown as exaggerated in size.

The solid-line curve represents a portion of a boundary Ba of the gamut Ga under "CONDITION A". The shorter-dot-line curve represents a portion of a boundary Bb of the gamut Gb under "CONDITION B". The dot-and-dash-line curve represents a portion of a boundary Bc of the gamut Gc under "CONDITION C". The longer-dot-line curve represents a portion of a boundary Bd of the gamut Gd under "CONDI-

TION D". The two-dot-and-dash-line curve represents a portion of a boundary Be of the gamut Ge under "CONDITION E".

The reproducibility judging section **90** judges whether the designated color can be reproduced or not by referring to the positional relationship between the gamuts Ga through Ge and a single colorimetric value, e.g., DC1. The three dots shown in FIG. **6** correspond to colorimetric values DC1, DC2, DC3, respectively of the designated color. Though only one designated color is selected in reality, the colorimetric values DC1, DC2, DC3 thereof are simultaneously shown for illustrative purposes.

Thereafter, the data generator **94** generates evaluation result data **64** from the judgment result produced by the reproducibility judging section **90**. The evaluation result data **64** indicate that on condition the designated color has the colorimetric value DC1, then it can be reproduced under "CONDITION A", "CONDITION B", "CONDITION C", "CONDITION D", and "CONDITION E".

In step S**5**, the color reproduction assisting system **40** performs a transmitting and receiving process on the evaluation result data **64**. Prior to the transmitting and receiving process, the server **16** temporarily stores the evaluation result data **64** in the memory **76**. The server **16** then transmits communication data including the evaluation result data **64** through the communication I/F **72** to the working terminal **18**. The working terminal **18** receives the communication data through the LAN **26** and the terminal I/F **52**. Thereafter, the terminal controller **50** temporarily stores the evaluation result data **64** included in the communication data in the terminal memory **58**.

In step S**6**, the working terminal **18** displays an evaluation result (particularly, a judgment result) represented by the evaluation result data **64** acquired in step S**5** on the display device **34**. Specifically, the display screen generator **66** generates display data for an evaluation result screen **140** (see FIG. **7**A), and then supplies the generated display data through the display I/F **56** to the display device **34**, which displays a new window W2 including the evaluation result screen **140**.

As shown in FIG. **7**A, the evaluation result screen **140** includes a list **142** (hereinafter referred to as "result list **142**") of evaluation results under the respective printing conditions **60**, a reproduction ratio indicating field **144** for quantitatively indicating the reproduction ratio of a designated color, and a button **146** labeled "CLOSE". The result list **142** includes a subfield **150** showing allotted degrees of importance on a left side, a subfield **151** showing condition names, and a subfield **152** showing judgment results.

The subfield **151** shows the same details as those shown in the subfield **113** (FIG. **5**), i.e., the enumerated names of the five printing conditions **60** illustrated in FIG. **5**. The subfield **150** shows circles **154** in locations associated respectively with "CONDITION A" and "CONDITION B". The circles **154** correspond respectively to the printing conditions **60** whose checkboxes **114** (FIG. **5**) are ticked.

The subfield **152** shows judgment results about whether the designated color can be reproduced under the printing conditions **60** or not. On condition that the designated color has the colorimetric value DC1 (see FIG. **6**), then the designated color belongs to every one of the gamuts Ga through Ge. In this case, the subfield **152** shows "OK", indicating that the designated color can be reproduced, in locations associated respectively with "CONDITION A", "CONDITION B", "CONDITION C", "CONDITION D", and "CONDITION E".

The reproduction ratio indicating field **144** shows "OVERALL 100% (5/5)" in its upper tier, which indicates a reproduction ratio about all the printing conditions **60** (five printing conditions in FIG. **7**A) to be evaluated. The reproduction ratio indicating field **144** shows "IMPORTANT 100% (2/2)" in its lower tier, which indicates a reproduction ratio about those printing conditions **60** to be evaluated whose degrees of importance are higher (two printing conditions **60**, i.e., "CONDITION A" and "CONDITION B").

On the condition that the designated color has the colorimetric value DC2 (see FIG. **6**), then the designated color belongs to the four gamuts Ga through Gd, but does not belong to the gamut Ge. At this time, the display device **34** displays a window W2 including an evaluation result screen **140** shown in FIG. **7**B, rather than the evaluation result screen **140** shown in FIG. **7**A.

The evaluation result screen **140** shown in FIG. **7**B includes a result list **142** having subfields **150**, **151**, **152**, a reproduction ratio indicating field **144**, and a button **146**, which are identical to those shown in FIG. **7**A. In the evaluation result screen **140** shown in FIG. **7**B, the subfield **152** shows "OK", indicating that the designated color can be reproduced, in locations associated respectively with "CONDITION A", "CONDITION B", "CONDITION C", and "CONDITION D", and shows "N/A", indicating that the designated color cannot be reproduced, in a location associated with "CONDITION E", and the reproduction ratio indicating field **144** shows "OVERALL 80% (4/5)" in its upper tier although it shows "IMPORTANT 100% (2/2)" in its lower tier.

In step S**7** shown in FIG. **4**, the operator confirms the details shown in the evaluation result screens **140** shown in FIGS. **7**A and **7**B, and judges whether the printing conditions **60** and the designated color information **62** should be finalized as they are or not.

On condition that the operator judges that the printing conditions **60** and the designated color information **62** should not be finalized (S**7**: NO), then control goes back to step S**1** and repeats steps S**1** through S**7**, i.e., the operator makes settings in the first setting field **102** and the second setting field **104** and the reproducibility of the designated color is evaluated, thereby selecting optimum printing conditions **60** and designated color information **62**.

On condition that the operator judges that the printing conditions **60** and the designated color information **62** should be finalized (S**7**: YES), then the operation of the color reproduction assisting system **40** comes to an end. The printing press **24** produces a print **22** that has images on a print medium **36**, based on the output data supplied from the print server **20**. As a result, the designated color is faithfully reproduced in a certain area on the print **22**.

[Function to Search for Substitute Color]

The color reproduction assisting system **40** can perform a function to search for a substitute color. The function to search for a substitute color will be described below. The "substitute color" refers to a color as a substitute for a designated color, and represents a color in the vicinity of a designated color.

On condition that the designated color has the colorimetric value DC3 (see FIG. **6**), then the designated color belongs to the three gamuts Ga, Gd, Ge, but does not belong to the two gamuts Gb, Gc. At this time, the display device **34** displays a window W2 including an evaluation result screen **140** shown in FIG. **8**, rather than the evaluation result screen **140** shown in FIG. **7**A.

The evaluation result screen **140** shown in FIG. **8** includes a result list **142** having subfields **150**, **151**, **152**, a reproduction

ratio indicating field **144**, and a button **146**, which are identical to those shown in FIG. **7**A. In the evaluation result screen **140** shown in FIG. **8**, the subfield **152** shows "OK", indicating that the designated color can be reproduced, in locations associated respectively with "CONDITION A", "CONDITION D", and "CONDITION E", and shows "N/A", indicating that the designated color cannot be reproduced, in locations associated respectively with "CONDITION B" and "CONDITION C", and the reproduction ratio indicating field **144** shows "OVERALL 60% (3/5)" in its upper tier and shows "IMPORTANT 50% (1/2)" in its lower tier.

The evaluation result screen **140** also includes a button **148** labeled "SEARCH FOR SUBSTITUTE COLOR" directly above the "CLOSE" button **146**. The "SEARCH FOR SUBSTITUTE COLOR" button **148** doubles as an indicator for letting the operator know that there are "CONDITION B" and "CONDITION C" under which the designated color cannot be reproduced, among the printing conditions **60**.

In a case where the operator clicks on the "SEARCH FOR SUBSTITUTE COLOR" button **148**, the color reproduction characteristics evaluator **84** further carries out an evaluating process with respect to the reproducibility of a designated color. The details of the operation sequence up to the evaluating process are basically identical to steps S**1** through S**4** (FIG. **4**), and will not be described below.

The substitute color determiner **92** determines, under a certain condition, a substitute color in order to increase the number of printing conditions **60** under which the designated color can be reproduced. The "certain condition" refers to a situation in which there is at least one of the printing conditions **60** under which the designated color cannot be reproduced. A process of searching for a substitute color will be described below with reference to FIGS. **9**A and **9**B. FIGS. **9**A and **9**B show at an enlarged scale a graph that corresponds to an area around the colorimetric value DC3 shown in FIG. **6**.

FIG. **9**A illustrates an example wherein the number of printing conditions **60** under which the designated color can be reproduced is incremented by 1. On condition that the number (**4** in FIG. **9**A) of printing conditions **60** under which the designated color can be reproduced remains the same, then the substitute color determiner **92** determines a color whose color difference from the designated color is minimum as a substitute color. As a result, the substitute color determiner **92** determines a colorimetric value RC31 that is present on the boundary Bb and spaced from the colorimetric value DC3 by a minimum distance, as a substitute color.

In the example shown in FIG. **9**A, the substitute color determiner **92** can be said to have determined a substitute color so that the designated color can be reproduced under all the printing conditions **60** whose degrees of importance are higher, i.e., "CONDITION A" and "CONDITION B".

FIG. **9**B illustrates an example wherein the number of printing conditions **60** under which the designated color can be reproduced is incremented by 2. The substitute color determiner **92** determines a color which can be reproduced under all the printing conditions **60** and whose color difference from the designated color is minimum, as a substitute color. As a result, the substitute color determiner **92** determines a colorimetric value RC32 that is present on the boundary Bc and spaced from the colorimetric value DC3 by a minimum distance, as a substitute color.

In step S**6**, the working terminal **18** displays an evaluation result (particularly, a search result) acquired in step S**5** on the display device **34**. Specifically, the display screen generator **66** generates display data for a search result screen **160**, and then supplies the generated display data through the display I/F **56** to the display device **34**, which displays a new window W3 including the search result screen **160**.

The search result screen **160** shown in FIG. **10** includes a search display field **162** for showing a search result about the designated color and a button **164** labeled "CLOSE". The search display field **162** includes a result list **142** having subfields **150**, **151**, **152**, which are similar to those shown in FIG. **7**A or the like. The search display field **162** also includes a colorimetric value display field **166** for showing colorimetric values of designated colors and substitute colors, a color difference display field **168** for showing a color difference, and a color patch group **170**.

The colorimetric value display field **166** includes a subfield **172** showing types of colorimetric values on a left side, a subfield **173** showing colorimetric values DC3 (FIG. **6**) of designated colors in the middle, and a subfield **174** showing colorimetric values RC31 (FIG. **9**A) of substitute colors on a right side.

The color difference display field **168** shows the color difference Δe between a colorimetric value DC3 and a colorimetric value RC31. The color patch group **170** includes a color patch **170***d* of a designated color, i.e., a color representing a colorimetric value DC3, and a color patch **170***r* of a substitute color, i.e., a color representing a colorimetric value RC31, the color patches **170***d*, **170***r* being arranged in a juxtaposed array. The visible information thus displayed by the color difference display field **168** allows the operator to grasp the relationship between a designated color and a substitute color at a glance.

In a case where the operator clicks on another tab **176** of the search display field **162**, the search result screen **160** shown in FIG. **10** switches to a search result screen **160** shown in FIG. **11**, changing details of the search display field **162**. A comparison between FIGS. **10** and **11** indicates that details displayed in the subfields **152**, **174** and the color difference display fields **168** are different from each other. The displayed color of the color patch **170***r* is also slightly changed in a case where the search result screen **160** shown in FIG. **10** switches to the search result screen **160** shown in FIG. **11**.

Since a plurality of substitute colors (colorimetric values RC31, RC32) obtained according to difference color searching processes are presented at a time, the operator is given a wider choice of alternatives and may find it more convenient. Various known algorithms are available for the color searching processes. For example, the target (evaluation index) of a minimization algorithm may be not only color difference, but also lightness and saturation.

[Advantages of Color Reproduction Assisting System **40**]

The color reproduction assisting system **40** includes the printing condition acquirer **86** that acquires a plurality of printing conditions **60**, the designated color information acquirer **88** that acquires designated color information **62** with respect to a single designated color, the reproducibility judging section **90** that judges whether the designated color specified from the designated color information **62** can be reproduced under the printing conditions **60**, the substitute color determiner **92** that determines a substitute color that is different from the designated color in order to increase the number of printing conditions **60** under which the designated color can be reproduced on condition that at least one of the printing conditions **60** under which the designated color cannot be reproduced is judged as being present, and the display device **34** that displays visible information (the colorimetric value display field **166**, the color difference display field **168**, and the color patch group **170**) with respect to the substitute color. The color reproduction assisting system **40** thus con-

figured is capable of presenting particularly useful information in reproducing the single designated color under the printing conditions **60**.

[Modifications]

Configurational and operational details of a color reproduction assisting system **200** (see FIG. **12**) according to a modification of the above embodiment will be described below.

As shown in FIG. **12**, the color reproduction assisting system **200** has a working terminal **202** and a display device **34**. The working terminal **202** includes a terminal controller **204** instead of the terminal controller **50** (FIG. **2**), and is otherwise identical to the working terminal **18**. The terminal controller **204** reads out and executes programs stored in the terminal memory **58** thereby to carry out functions including the display screen generator **66**, the data acquirer **82**, and the color reproduction characteristics evaluator **84**.

In the color reproduction assisting system **200**, the working terminal **202** operates to evaluate the reproducibility of a designated color. The color reproduction assisting system **200** thus configured offers the same advantages as those of the color reproduction assisting system **40** according to the above embodiment. In steps S**2**, S**3** shown in FIG. **4**, the working terminal **202** needs to send a transmission request to the server **16** for acquiring a plurality of color profiles **78** and colorimetric data **80**. As the working terminal **202** itself evaluates the reproducibility of a designated color, the transmitting and receiving process about the evaluation result in step S**5** shown in FIG. **4** is not necessary.

Although the preferred embodiments of the present invention have been described in detail above, the present invention is not limited to the embodiments, but various many changes and modifications may be made to the embodiments without departing from the scope of the appended claims.

What is claimed is:

1. A color reproduction assisting system comprising:

a printing condition acquirer that acquires a plurality of printing conditions;

a designated color information acquirer that acquires designated color information with respect to a single designated color;

a reproducibility judging section that judges whether the designated color specified from the designated color information acquired by the designated color information acquirer can be reproduced under the printing conditions acquired by printing condition acquirer or not;

a substitute color determiner that determines a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present by the reproducibility judging section; and

a display device that displays visible information with respect to the substitute color determined by the substitute color determiner,

wherein the display device displays a color patch of the designated color and a color patch of the substitute color, arranged in a juxtaposed array as the visible information.

2. The color reproduction assisting system according to claim **1**, wherein the substitute color determiner determines a color whose color difference from the designated color is minimum as the substitute color on condition that the number of the printing conditions under which the designated color can be reproduced remains the same.

3. The color reproduction assisting system according to claim **1**, wherein the printing condition acquirer further acquires degrees of importance allotted to the printing conditions, respectively; and

the substitute color determiner determines the substitute color so that the designated color can be reproduced under all printing conditions whose degrees of importance are higher than other printing conditions.

4. A color reproduction assisting method comprising:

using one or more computers to perform:

acquiring a plurality of printing conditions;

acquiring designated color information with respect to a single designated color;

judging whether the designated color specified from the designated color information can be reproduced under the printing conditions that are acquired or not;

determining a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present; and

displaying visible information on a display device with respect to the substitute color that is determined,

wherein the display device displays a color patch of the designated color and a color patch of the substitute color, arranged in a juxtaposed array as the visible information.

5. A non-transitory computer readable storage medium storing a program for enabling at least one computer to carry out the steps of:

acquiring a plurality of printing conditions;

acquiring designated color information with respect to a single designated color;

judging whether the designated color specified from the designated color information can be reproduced under the printing conditions that are acquired or not;

determining a substitute color that is different from the designated color in order to increase number of the printing conditions under which the designated color can be reproduced on condition that at least one of the printing conditions under which the designated color cannot be reproduced is judged as being present; and

displaying visible information on a display device with respect to the substitute color that is determined,

wherein the display device displays a color patch of the designated color and a color patch of the substitute color, arranged in a juxtaposed array as the visible information.

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